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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/079,292	02/20/2002	Naoya Hasegawa	9281-4288	6615

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EXAMINER	
MAGEE, CHRISTOPHER R	
ART UNIT	**PAPER NUMBER**
2653	

DATE MAILED: 03/25/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 10/079,292	Applicant(s) HASEGAWA ET AL.
	Examiner Christopher R. Magee	Art Unit 2653

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *10 February 2005*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-76* is/are pending in the application.

4a) Of the above claim(s) *26-76* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-25* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *20 February 2002* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *2/20/02*.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application (PTO-152)

6) ☐ Other: _____.

DETAILED ACTION

Election/Restrictions

1. Applicant's election of Species A, Figures 1 and 19, claims 1-25, in the reply filed on 2/10/2005 is acknowledged. Because applicant did not distinctly and specifically point out the supposed errors in the restriction requirement, the election has been treated as an election without traverse (MPEP § 818.03(a)).

2. Claims 26-76 are withdrawn from further consideration pursuant to 37 CFR 1.142(b), as being drawn to a nonelected species, there being no allowable generic or linking claim. Applicant timely traversed the restriction (election) requirement in the reply filed on 2/10/2005.

Priority

3. Receipt is acknowledged of papers submitted under 35 U.S.C. 119(a)-(d), which papers have been placed of record in the file.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims 1-13, 18 and 20-22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Gill (US 6,456,469 B1) in view of Lee et al. (hereinafter Lee) (US 5,731, 936).

- Regarding claims 1-5, Gill teaches a spin valve sensor with a seed layer [408] formed on top of the substrate [406] [col. 6, lines 65-67];

an antiferromagnetic layer [410], and

a ferromagnetic layer [414],

the seed layer [408], the antiferromagnetic layer [410], and the ferromagnetic layer [414] being deposited in that order from the bottom, magnetization of the ferromagnetic layer being directed in a predetermined direction by an exchange coupling magnetic field produced at an interface between the antiferromagnetic layer and the ferromagnetic layer [Fig. 5; col. 7, lines 42-57], a thickness of the seed layer is 10 to 200 Å [col. 7, lines 10-11], and a crystal structure of the seed layer is a face-centered cubic structure [col. 7, lines 2-9].

Gill does not show a nonmagnetic seed layer comprising α and Cr, α being at least one of Fe, Ni, and Co, wherein a Cr content of the seed layer is 35 to 60 atomic percent.

Lee discloses a nonmagnetic seed layer comprising α and Cr, α being at least one of Fe, Ni, and Co, wherein a Cr content of the seed layer is 35 to 60 atomic percent [col. 6, lines 15-24].

It would have been obvious to one of ordinary skill in the art at the time the invention was made to provide the spin valve sensor of Gill with a nonmagnetic seed layer comprising α and Cr, α being at least one of Fe, Ni, and Co, wherein a Cr content of the seed layer is 35 to 60 atomic percent as taught by Lee.

The rationale is as follows: One of ordinary skill in the art at the time of the invention would have been motivated to provide the spin valve sensor of Gill with the seed layer as taught

by Lee in order to increase the thermal stability so that the sense current can be increased [Lee; col. 2, lines 46-50].

- Regarding claim 6, Gill discloses the thickness of the seed layer is at most 80 Å [col. 7, lines 10-11].

- Regarding claim 7, Gill discloses the thickness of the seed layer is at most 60 Å [col. 7, lines 10-11].

- Regarding claims 8-11, Gill shows all the features, *supra*, but does not disclose the seed layer comprises one of a NiFeCr alloy and a NiCr alloy, wherein the seed layer has a composition represented by $(Ni_{100-x} Fe_x)$-Cr, and an atomic ratio x satisfies the relationship $0 \leq x \leq 70$, $0 \leq x \leq 50$ or $0 \leq x \leq 30$.

Lee teaches a seed layer comprises one of a NiFeCr and a NiCr alloy, wherein the seed layer has a composition represented by $(Ni_{100-x} Fe_x)$-Cr, and an atomic ratio x satisfies the relationship $0 \leq x \leq 70$, $0 \leq x \leq 50$ or $0 \leq x \leq 30$ [col. 2, lines 52-63; col. 6, lines 15-24].

It would have been obvious to one of ordinary skill in the art at the time the invention was made to provide the spin valve sensor of Gill with a seed layer as taught by Lee.

The rationale is as follows: One of ordinary skill in the art at the time of the invention would have been motivated to provide the spin valve sensor of Gill with the seed layer as taught by Lee in order to increase the thermal stability so that the sense current can be increased [Lee; col. 2, lines 46-50]. Plus, the improvement results in larger grains with fewer defects, which

contributes to increasing the MR coefficient of the MR stripe [Lee; col. 2, line 64 to col. 3, line 2].

- Regarding claims 12 and 13, Gill discloses all the features, *supra*, but does not teach an underlayer formed below the seed layer and comprising at least one element selected from Ta, Hf, Nb, Zr, Ti, Mo and W, wherein the seed layer is formed by sputtering.

Lee discloses an underlayer formed below the seed layer and comprising at least one element selected from Ta, Hf, Nb, Zr, Ti, Mo and W [col. 2, lines 51-54], wherein the seed layer is formed by sputtering [col. 5, lines 41-56].

It would have been obvious to one of ordinary skill in the art at the time the invention was made to provide the spin valve sensor of Gill with an underlayer formed below the seed layer as taught by Lee.

The rationale is as follows: One of ordinary skill in the art at the time of the invention would have been motivated to provide the spin valve sensor of Gill with an underlayer formed below the seed layer as taught by Lee in order to increase the MR coefficient of the magnetoresistive element [Lee; col. 2, lines 51-54].

- Regarding claim 18, Gill discloses the grain boundaries formed in the antiferromagnetic layer and the grain boundaries formed in the seed layer which appear in a cross section of the exchange coupled film parallel to a thickness direction are at least partially discontinuous at an interface between the antiferromagnetic layer and the seed layer [col. 6, lines 25-32].

- Regarding claim 20, Gill discloses the equivalent crystal planes represented as {111} planes in the antiferromagnetic layer and the seed layer are preferentially oriented as crystal planes parallel to the interface between the antiferromagnetic layer and the seed layer, and at least some of the equivalent crystal axes in the crystal planes are directed in different directions between the antiferromagnetic layer and the seed layer [col. 6, lines 25-32].

- Regarding claim 21, Gill teaches the antiferromagnetic layer comprises X and Mn, wherein X is at least one element selected from the group consisting of Pt, Pd, Ir, Rh, Ru, and Os [col. 7, lines 15-20].

- Regarding claim 22, Gill teaches the antiferromagnetic layer comprises X-Mn-X' alloy, wherein X is at least one element selected from the group consisting of Pt, Pd, Ir, Rh, Ru, and Os, and X' is at least one element selected from the group consisting of Ne, Ar, Kr, Xe, Be, B, C, N, Mg, Al, Si, P, Ti, V, Cr, Fe, Co, Ni, Cu, Zn, Ga, Ge, Zr, Nb, Mo, Ag, Cd, lr, Sn, Hf, Ta, W, Re, Au, Pb, and rare-earth elements. [col. 7, lines 15-20].

5. Claims 14-16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Gill (US 6,456,469 B1) and Lee et al. (hereinafter Lee) (US 5,731, 936), as applied to claim 1 above and further in view of Ohta et al. (hereinafter Ohta) (US 5,958,611).

- Regarding claims 14-16, Gill and Lee disclose all the features, *supra*, but do not disclose an average grain size in a direction parallel to a layer surface in each layer formed on the seed layer is at least 100 Å.

Ohta teaches a crystal grain size D of composition forming the oxide antiferromagnetic layer [50] in the range of 10 to 40 nm (i.e., 100 to 400 Å), more preferably 20 to 40 nm [col. 8, lines 1-4].

It would have been obvious to one of ordinary skill in the art at the time the invention was made to set the average grain size of each layer of Gill and Lee within the parameters as taught by Ohta.

The rationale is as follows: One of ordinary skill in the art at the time of the invention would have been motivated to set the average grain size of each layer of Gill and Lee within the parameters as taught by Ohta in order to obtain a sufficiently large exchange biasing magnetic field [Ohta; col. 4, lines 38-40].

6. Claims 17, 19 and 23-25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Gill (US 6,456,469 B1) and Lee et al. (hereinafter Lee) (US 5,731, 936), as applied to claim 1 above and further in view of Hasegawa et al. (hereinafter Hasegawa '647) (English translation of JP 11-191647, publication date 7/13/1999).

- Regarding claim 17, Gill and Lee disclose all the features, *supra*, but do not disclose the grain boundaries formed in the antiferromagnetic layer and the grain boundaries formed in the ferromagnetic layer which appear in a cross section of the exchange coupled film parallel to a

thickness direction are at least partially discontinuous at the interface between the antiferromagnetic layer and the ferromagnetic layer.

Hasegawa'647 teaches the grain boundaries formed in the antiferromagnetic layer and grain boundaries formed in the ferromagnetic layer which appear in a cross section of the exchange coupled film parallel to a thickness direction are at least partially discontinuous at the interface between the antiferromagnetic layer and the ferromagnetic layer [Hasegawa English translation, section 0017].

It would have been obvious to one of ordinary skill in the art at the time the invention was made to form the grain boundaries between the antiferromagnetic layer and the ferromagnetic layer of Gill and Lee in a discontinuous state as taught by Hasegawa '647.

The rationale is as follows: One of ordinary skill in the art at the time of the invention would have been motivated to form the grain boundaries between the antiferromagnetic layer and the ferromagnetic layer of Gill and Lee in a discontinuous state as taught by Hasegawa '647 so that an increased exchange anisotropic magnetic field can be obtained when the interface structure is in a discontinuous state [Hasegawa English translation, sections 0017 to 0018].

- Regarding claim 19, Gill and Lee disclose all the features, *supra*, but do not disclose equivalent crystal planes represented as {111} planes in the antiferromagnetic layer and the ferromagnetic layer are preferentially oriented as crystal planes parallel to the interface between the antiferromagnetic layer and the ferromagnetic layer, and at least some of the equivalent crystal axes in the crystal planes are directed in different directions between the antiferromagnetic layer and the ferromagnetic layer.

Hasegawa'647 teaches equivalent crystal planes represented as {111} planes in the antiferromagnetic layer and the ferromagnetic layer are preferentially oriented as crystal planes parallel to the interface between the antiferromagnetic layer and the ferromagnetic layer, and at least some of the equivalent crystal axes in the crystal planes are directed in different directions between the antiferromagnetic layer and the ferromagnetic layer [Hasegawa English translation, section 0021].

It would have been obvious to one of ordinary skill in the art at the time the invention was made to form the equivalent crystal planes between the antiferromagnetic layer and the ferromagnetic layer of Gill and Lee in different directions as taught by Hasegawa '647.

The rationale is as follows: One of ordinary skill in the art at the time of the invention would have been motivated to form the equivalent crystal planes between the antiferromagnetic layer and the ferromagnetic layer of Gill and Lee in different directions as taught by Hasegawa '647 so that an increased exchange anisotropic magnetic field can be obtained when the interface structure is in a discontinuous state [Hasegawa English translation, sections 0017 to 0018].

- Regarding claim 23, Gill and Lee disclose all the features, *supra*, but do not disclose the X-Mn-X' alloy is one of an interstitial solid solution in which atoms of X' enter interstices in a space lattice comprising X and Mn and a substitutional solid solution in which atoms of X' are substituted for some atoms at lattice points of a crystal lattice comprising X and Mn.

Hasegawa'647 teaches the X-Mn-X' alloy is one of an interstitial solid solution in which atoms of X' enter interstices in a space lattice comprising X and Mn and a substitutional solid

solution in which atoms of X' are substituted for some atoms at lattice points of a crystal lattice comprising X and Mn [Hasegawa English translation, section 0023].

It would have been obvious to one of ordinary skill in the art at the time the invention was made to form the X-Mn-X' alloy of Gill and Lee as an interstitial solid solution as taught by Hasegawa '647.

The rationale is as follows: One of ordinary skill in the art at the time of the invention would have been motivated to form the X-Mn-X' alloy of Gill and Lee as an interstitial solid solution as taught by Hasegawa '647 in order to increase the lattice constant of the antiferromagnetic layer so that the interface structure between the antiferromagnetic layer and the ferromagnetic layer can be incoherent [Hasegawa English translation, sections 0043].

- Regarding claim 24, Gill and Lee disclose all the features, *supra*, but do not disclose the X content of the antiferromagnetic layer is 45 to 60 atomic percent.

Hasegawa'647 teaches the X content of the antiferromagnetic layer is 45 to 60 atomic percent [Hasegawa English translation, section 0027].

It would have been obvious to one of ordinary skill in the art at the time the invention was made to make the antiferromagnetic layer of Gill and Lee with the X content as taught by Hasegawa '647.

The rationale is as follows: One of ordinary skill in the art at the time of the invention would have been motivated to make the antiferromagnetic layer of Gill and Lee with the X content as taught by Hasegawa '647 in order to control the composition ratio of element X of the X-Mn alloy so that the difference between the lattice constant of the X-Mn alloy and the lattice

constant of the ferromagnetic layer is large before heat treatment. Since the difference is large, the interface structure between the X-Mn alloy and the ferromagnetic layer is easily put into the incoherent state (before heat treatment) [Hasegawa English translation, sections 0042].

- Regarding claim 25, Gill and Lee disclose all the features, *supra*, but do not disclose the X + X' content of the antiferromagnetic layer is 45 to 60 atomic percent

Hasegawa'647 teaches the X + X' content of the antiferromagnetic layer is 45 to 60 atomic percent [Hasegawa English translation, section 0028].

It would have been obvious to one of ordinary skill in the art at the time the invention was made to make the antiferromagnetic layer of Gill and Lee with the X+X' content as taught by Hasegawa '647.

The rationale is as follows: One of ordinary skill in the art at the time of the invention would have been motivated to make the antiferromagnetic layer of Gill and Lee with the X + X' content as taught by Hasegawa '647 in order to control the composition ratio of element X of the X-Mn alloy so that the difference between the lattice constant of the X-Mn alloy and the lattice constant of the ferromagnetic layer is large before heat treatment. Since the difference is large, the interface structure between the X-Mn alloy and the ferromagnetic layer is easily put into the incoherent state (before heat treatment). Furthermore, by adding element X' such as a rare gas element to the X-Mn alloy, the lattice constant of the antiferromagnetic layer can be increased to bring the interface structure between the antiferromagnetic layer and the ferromagnetic layer into a incoherent state [Hasegawa English translation, sections 0043 to 0042].

Conclusion

7. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Christopher R. Magee whose telephone number is (571) 272-7592. The examiner can normally be reached on M-F, 8: 00 am-5: 30 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, William Korzuch can be reached on (571) 272-7589. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

3/17/2005

Christopher R. Magee
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